

SEMICONDUCTOR STRUCTURE WITH CONTROLLING BASE" (Attorney Docket No. 10007287-1).

**IN THE CLAIMS:**

*Please cancel claims 15-20 without prejudice.*

*Please amend the following claim(s).*

- Sub B1
1. (Once Amended) An electron emitter comprising:
- a p region;
  - a dielectric layer formed above said p region;
  - a metallic layer formed above said dielectric layer; and
  - means for emitting electrons through said metallic layer.

*Please add the following claim(s).*

- Sub B2-7
21. (NEW) An electron emitter comprising:
- a p region;
  - a dielectric layer formed above said p region;
  - a metallic layer formed above said dielectric layer; and
  - at least one voltage biasing source electrically connected to said p region and said metallic layer such that electrons pass through said metallic layer.

22. (NEW) The electron emitter according to claim 21, wherein said at least one voltage biasing source is connected such that said electrons tunnel through said dielectric layer prior to passing to said metallic layer.

23. (NEW) The electron emitter according to claim 21, further comprising at least one of:

a p electrode formed above and making electrical contact with said p region; and  
an M electrode formed above and making electrical contact with said metallic layer.

24. (NEW) The electron emitter according to claim 21, further comprising:  
an n+ region such that said p region is formed within said n+ region.

25. (NEW) The electron emitter according to claim 24, wherein an electron concentration level of said n+ region is greater than a hole concentration level of said p region.

26. (NEW) The electron emitter according to claim 24, wherein said n+ region is formed from materials with wider band gap than said p region.

27. (NEW) The electron emitter according to claim 24, wherein a thickness of said p region is less than a diffusion length of non-equilibrium electrons in said p region.

28. (NEW) The electron emitter according to claim 24, further comprising:  
an n electrode formed above and making electrical contact with said n+ region.

29. (NEW) The electron emitter according to claim 21, wherein a thickness of said metallic layer is on the order of or less than a mean free path for electron energy.

Sub B3/ 30. (NEW) The electron emitter according to claim 21, wherein a thickness of said dielectric layer is such that a dielectric breakdown field  $F_b$  of said dielectric layer substantially meets the condition  $1.5 * 10^7 \text{ V/cm} \leq F_b \leq 2 * 10^7 \text{ V/cm}$ .

31. (NEW) The electron emitter according to claim 1, wherein a thickness of said dielectric layer is such that a dielectric breakdown field  $F_b$  of said dielectric layer substantially meets the condition  $1.5 * 10^7 \text{ V/cm} \leq F_b \leq 2 * 10^7 \text{ V/cm}$ .

32. (NEW) An electron emitter comprising:  
an n+ region;  
a p region above said n+ region;  
a dielectric layer formed above said p region;  
a metallic layer formed above said dielectric layer; and  
at least one voltage biasing source electrically connected to said n+ region and to at least one of said p region and said metallic layer such that a potential on said p region is positive relative to said n+ region.

33. (NEW) An electron emitter, comprising:  
an n+ region;  
an n electrode in electrical contact with said n+ region;  
a p region above and in contact with said n+ region;  
a p electrode in electrical contact with said p region;  
a dielectric layer formed above said p region;  
a metallic layer formed above said dielectric layer;  
an M electrode in electrical contact with said metallic layer; and

at least one voltage biasing source connected to at least one of said n, p, and M electrodes such that electrons tunnel through said dielectric layer and pass through said metallic layer.

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### **PENDING CLAIMS**

By this reply, claims 15-20 have been canceled, claims 21-33 have been added, and claim 1 has been amended. Thus, claims 1-14 and 21-33 are pending. Of these, claims 1, 21, 32, and 33 are independent.

### **AFFIRMATION OF ELECTION OF CLAIMS WITHOUT TRAVERSE**

In the Office Action, originally submitted claims 1-20 have been restricted to the following groups:

- I. Claims 1-14, drawn to an electron emitter, classified in class 257, subclass 10; and
- II. Claims 15-20, drawn to a method to fabricate an electron emitter, classified in class 438, subclass 309.

Applicants hereby affirm the election made to prosecute group I claims (claims 1-14) as required in the Office Action (see page 3 of the Office Action).

### **OBJECTION TO THE SPECIFICATION**

In the Office Action, the disclosure has been objected to for not including the US application serial number of an application intended to be incorporated by reference. As shown above, the application serial number of the reference has now been incorporated.

Applicants respectfully request the objection to the specification be withdrawn.

**REJECTION BASED ON '084 PATENT**

In the Office Action, claims 1-6 and 14 have been rejected under 35 U.S.C. §102(b) as allegedly being anticipated by van Gorkum et al., U.S. Patent No. 4,325,084 (the '084 patent). Applicants respectfully traverse.

When making a rejection under 35 U.S.C. § 102, the cited reference must teach every aspect of the claimed invention either explicitly or impliedly. Any feature not directly taught must be inherently present. *See M.P.E.P. § 706.02; M.P.E.P. § 2131.01.* If the cited reference does not teach or suggest every element of the claimed invention, then the cited reference fails to anticipate or render obvious the claimed invention, i.e. the claimed invention is distinguishable over the cited reference.

With respect to independent claim 1, the '084 patent fails to disclose or suggest every element of this independent claim. Because the '084 patent fails to disclose or suggest every element, claim 1 is not anticipated or rendered obvious by the '084 patent, i.e. it is distinguishable over the '084 patent.

For example, independent claim 1 recites, *inter alia*, “means for emitting electrons through said metallic layer”. In contrast, the '084 patent specifically indicates that the electrons are emitted through the surface region 13 as indicated by arrow 14 on Figure 2. The '084 patent does not teach or suggest that the electrons are emitted through the electrode 8. Indeed, the device as disclosed in the '084 patent can only emit electrons through the surface region 13 since the '084 device works by applying a reverse bias voltage across the p-n junction, i.e. the potential on the p-type region 3 is negative relative to the potential on the n-type region 2 (see Figures 2-4; column 6, lines 31-33 and 56-58).

Thus, even assuming *arguendo* that the electrode 8 is equivalent to the metallic layer as claimed, it is clear that the '084 patent cannot teach or suggest at least means for emitting

electrons through the electrode 8. Therefore, independent claim 1 is distinguishable over the '084 patent.

Claims 2-6 and 14 depend from independent claim 1. Therefore, for at least the reasons stated above with respect to claim 1, these dependent claims are also distinguishable over the '084 patent.

Applicants respectfully request that the rejection of claims 1-6 and 14 based on the '084 patent be withdrawn.

### **REJECTION BASED ON '084 PATENT AND '536 PUBLICATION**

In the Office Action, claim 7 has been rejected under 35 U.S.C. § 103(a) as allegedly being obvious over the '084 patent in view of Koh et al., Publication No. US 2002/0033536 A1 (the '536 publication). Applicants respectfully traverse.

When making a rejection under 35 U.S.C. § 103, a necessary condition is that the combination of the cited references must teach or suggest all claim limitations. *See M.P.E.P. § 2142*. If the cited references do not teach or suggest every element of the claimed invention, then the cited references fail to render obvious the claimed invention, i.e. the claimed invention is distinguishable over the combination of the cited references.

Claim 7 directly or indirectly depends from independent claim 1, and claim 1 recites, *inter alia*, “means for emitting electrons through said metallic layer”. It has been shown above that the '084 patent does not teach or suggest at least this feature. The '536 publication fails to correct at least this deficiency of the '084 patent. Indeed, the device disclosed in the '536 publication is not an electron emitter of any type. Thus, the '536 publication cannot disclose emitting electrons at all.

Because neither the '084 patent nor the '536 publication teach or suggest at least the feature as claimed, the combination of the cited references cannot teach or suggest at least the

same feature. Thus, independent claim 1 is distinguishable over the combination of the '084 patent and the '536 publication. Therefore, claim 7, which depends from independent claim 1, is also distinguishable over the combination of the '084 patent and the '536 publication for at least the reasons stated with respect to claim 1.

Applicants respectfully request that the rejection of claim 7 based on the '084 patent and the '536 publication be withdrawn.

### **REJECTION BASED ON '084 AND '994 PATENTS**

In the Office Action, claims 8 and 13 have been rejected under 35 U.S.C. § 103(a) as allegedly being obvious over the '084 patent in view of Palara, US Patent No. 5,665,994 (the '994 patent). Applicants respectfully traverse.

Claims 8 and 13 depend from independent claim 1, and claim 1 recites, *inter alia*, "means for emitting electrons through said metallic layer". It has been shown above that the '084 patent does not teach or suggest at least this feature. The '994 patent fails to correct at least this deficiency of the '084 patent. Indeed, the device disclosed in the '994 patent is not an electron emitter of any type. Thus, the '994 patent cannot disclose emitting electrons at all.

Because neither the '084 nor the '994 patents teach or suggest at least the feature as claimed, the combination of the cited references cannot teach or suggest at least the same feature. Thus, independent claim 1 is distinguishable over the combination of the '084 and the '994 patents. Therefore, claims 8 and 13, which depend from independent claim 1, are also distinguishable over the combination of the '084 and the '994 patents for at least the reasons stated with respect to claim 1.

Applicants respectfully request that the rejection of claims 8 and 13 based on the '084 and the '994 patents be withdrawn.

**REJECTION BASED ON '084, '994 AND '141 PATENTS**

In the Office Action, claim 9 has been rejected under 35 U.S.C. § 103(a) as allegedly being obvious over the '084 patent in view of the '994 patent, and in further view of Suzuki et al., US Patent No. 5,329,141 (the '141 patent). Applicants respectfully traverse.

Claim 9 directly or indirectly depends from independent claim 1, and claim 1 recites, *inter alia*, “means for emitting electrons through said metallic layer”. It has been shown above that neither the '084 patent nor the '994 patent teaches or suggests at least this feature. The '141 patent fails to correct at least this deficiency of the '084 and the '994 patents. Indeed, the device disclosed in the '141 patent is not an electron emitter of any type. Thus, the '141 patent cannot disclose emitting electrons at all.

Because none of the '084, the '994, and the '141 patents teaches or suggests at least the feature as claimed, the combination of the cited references cannot teach or suggest at least the same feature. Thus, independent claim 1 is distinguishable over the combination of the '084, the '994, and the '141 patents. Therefore, claim 9, which depends from independent claim 1, is also distinguishable over the combination of the '084, the '994, and the '141 patents for at least the reasons stated with respect to claim 1.

Applicants respectfully request that the rejection of claim 9 based on the '084, the '994, and the '141 patents be withdrawn.

**REJECTION BASED ON '084, '994 AND '400 PATENTS**

In the Office Action, claim 10 has been rejected under 35 U.S.C. § 103(a) as allegedly being obvious over the '084 patent in view of the '994 patent, and in further view of Morishita et al., US Patent No. 5,140,400 (the '400 patent). Applicants respectfully traverse.

Claim 10 directly or indirectly depends from independent claim 1, and claim 1 recites, *inter alia*, “means for emitting electrons through said metallic layer”. It has been shown above that neither the ‘084 patent nor the ‘994 patent teaches or suggests at least this feature. The ‘400 patent fails to correct at least this deficiency of the ‘084 and the ‘994 patents. Indeed, the device disclosed in the ‘400 patent is not an electron emitter of any type. Thus, the ‘400 patent cannot disclose emitting electrons at all.

Because none of the ‘084, the ‘994, and the ‘400 patents teaches or suggests at least the feature as claimed, the combination of the cited references cannot teach or suggest at least the same feature. Thus, independent claim 1 is distinguishable over the combination of the ‘084, the ‘994, and the ‘400 patents. Therefore, claim 10, which depends from independent claim 1, is also distinguishable over the combination of the ‘084, the ‘994, and the ‘400 patents for at least the reasons stated with respect to claim 1.

Applicants respectfully request that the rejection of claim 10 based on the ‘084, the ‘994, and the ‘400 patents be withdrawn.

#### **REJECTION BASED ON ‘084, ‘994, AND ‘770 PATENTS**

In the Office Action, claim 11 has been rejected under 35 U.S.C. § 103(a) as allegedly being obvious over the ‘084 patent in view of the ‘994 patent, and in further view of Bronner et al., US Patent No. 6,242,770 B1 (the ‘770 patent). Applicants respectfully traverse.

Claim 11 directly or indirectly depends from independent claim 1, and claim 1 recites, *inter alia*, “means for emitting electrons through said metallic layer”. It has been shown above that neither the ‘084 patent nor the ‘994 patent teaches or suggests at least this feature. The ‘770 patent fails to correct at least this deficiency of the ‘084 and the ‘994 patents. Indeed, the device disclosed in the ‘770 patent is not an electron emitter of any type. Thus, the ‘770 patent cannot disclose emitting electrons at all.

Because none of the '084, the '994, and the '770 patents teaches or suggests at least the feature as claimed, the combination of the cited references cannot teach or suggest at least the same feature. Thus, independent claim 1 is distinguishable over the combination of the '084, the '994, and the '770 patents. Therefore, claim 11, which depends from independent claim 1, is also distinguishable over the combination of the '084, the '994, and the '770 patents for at least the reasons stated with respect to claim 1.

Applicants respectfully request that the rejection of claim 11 based on the '084, the '994, and the '770 patents be withdrawn.

#### **REJECTION BASED ON '084 AND '994 PATENTS AND '705 PUBLICATION**

In the Office Action, claim 12 has been rejected under 35 U.S.C. § 103(a) as allegedly being obvious over the '084 patent in view of the '994 patent, and in further view of Ishio et al., Publication No. US 2002/0014705 A1 (the '705 publication). Applicants respectfully traverse.

Claim 12 directly or indirectly depends from independent claim 1, and claim 1 recites, *inter alia*, “means for emitting electrons through said metallic layer”. It has been shown above that neither the '084 patent nor the '994 patent teaches or suggests at least this feature. The '705 publication fails to correct at least this deficiency of the '084 and the '994 patents. Indeed, the device disclosed in the '705 publication is not an electron emitter of any type. Thus, the '705 publication cannot disclose emitting electrons at all.

Because none of the '084 patent, the '994 patent, and the '705 publication teaches or suggests at least the feature as claimed, the combination of the cited references cannot teach or suggest at least the same feature. Thus, independent claim 1 is distinguishable over the combination of the '084 and the '994 patents and the '705 publication. Therefore, claim 12, which depends from independent claim 1, is also distinguishable over the combination of the

'084 and the '994 patents and the '705 publication for at least the reasons stated with respect to claim 1.

Applicants respectfully request that the rejection of claim 11 based on the '084 and the '994 patents and the '705 publication be withdrawn.

### **CLAIM ADDITIONS**

By this reply, claims 21-33 have been added. Of these, claims 21, 32, and 33 are independent. Independent claim 21 recites, *inter alia*, "at least one voltage biasing source connected such that electrons pass through said metallic layer." It has been shown above that none of the cited references teaches or suggests at least this feature. Therefore, independent claim 21 is distinguishable from all cited references, individually or in any combination.

Claims 22-30 depend from independent claim 21 directly or indirectly. Therefore, these dependent claims are distinguishable from all cited references, individually or in any combination, for at least the reasons stated with respect to independent claim 21.

Claim 31 depends from independent claim 1 and it has been shown above that claim 1 is distinguishable from all cited references. Therefore, these dependent claims are distinguishable from all cited references, individually or in any combination, for at least the reasons stated with respect to independent claim 1.

In addition, regarding claims 30 and 31, Applicants note that none of the cited references teaches or suggests the thickness of the dielectric layer is such that a dielectric breakdown field  $F_b$  of the dielectric layer substantially meets the condition  $1.5 * 10^7 \text{ V/cm} \leq F_b \leq 2 * 10^7 \text{ V/cm}$ .

Independent claim 32 recites, *inter alia*, "a voltage biasing source electrically connected such that a potential on said p region is positive relative to said n+ region." In contrast, the '084 patent specifically indicates the opposite, i.e. the p-n junction is reverse

biased (see Figures 2-4; column 6, lines 31-33 and 56-58). Other cited references cannot be used to correct at least this deficiency of the '084 patent since they are silent regarding junction biasing of any type. Even assuming *arguendo* that forward biasing may be inferred from any of the other cited references, they may not be combined with the '084 patent to the extent that the '084 teaches reverse biasing.

Independent claim 33 recites, *inter alia*, "at least one voltage biasing source connected ... such that electrons ... pass through said metallic layer." It has been shown above that none of the cited references teaches or suggests at least this feature. Therefore, claim 33 is distinguishable from all cited references.

Applicants respectfully request that the newly added claims 21-33 be accepted and allowed.